Bruising characteristics from unintentional injuries in children: the 'green flag' study

Mary Clyde Pierce

Bruising in young children is probably the most overlooked or underappreciated injury prior to a child being severely injured or killed at the hands of their caregiver/s. In fact, 28%–64% of children who sustained subsequent severe physical abuse injuries had prior 'sentinel' bruising that was overlooked or dismissed as insignificant by a professional providing care for the child.[1 2] This harm-causing oversight is likely driven by several factors: (1) bruising in and of itself rarely needs an intervention or treatment, and in medicine, we focus on findings (signs and symptoms) that need our immediate attention or add to our understanding of the patient's condition. Thus, we overlook what does not register as important. (2) Bruising is common, ubiquitous and, for the most part, an inconsequential finding on active toddlers and older children, and (3) even if the bruise is noticed, the clinician may not feel comfortable concluding whether a bruise is or is not likely to occur from any one stated cause. In the spirit of being 'non-accusatory with families', the clinician is more likely to give the family the 'benefit of the doubt' and not make judgements about the bruising and injury 'plausibility'.

Common trauma mechanisms that result in bruising include falls from standing or sitting, running/falling into an object (such as the edge of a coffee table), short falls of around 1 m (3.28 feet) (eg, fall off of furniture including a couch, bed, chair, swing, table, changing table and cabinets), stair falls, falls/drops from caregivers' arms, falls with the caregivers and falls off playground equipment. Other common injuries include being struck by an object (such as a toy) or being hit by another child. However, in many instances of bruising from abuse, the child's caregiver provides a fabricated history of trauma, similar to the above-listed examples, to conceal the abusive act.

ARE THERE KEY BRUISING DISTRIBUTIONS OR CHARACTERISTICS THAT HELP CLINICIANS DISTINGUISH BETWEEN TRUE AND FABRICATED HISTORIES OF INJURY?

Several studies have identified key findings in bruising characteristics ('red flags') between abused and unintentionally injured children, with a predominant focus on improved recognition of the abused child.[3–5] An enhanced understanding of detailed bruising characteristics associated with true accidental injury occurrences across different ages would add significantly to the evidence base required for clinicians to better assess injury plausibility and identify false or fabricated trauma histories. Knowing what bruises occur in accidental injury allows identification of false or fabricated trauma histories. This can lead to better differentiation of abusive versus accidental trauma at the individual patient level.

In the linked article titled 'Childhood bruising distribution observed from eight mechanisms of unintentional injury', authors Hibberd and colleagues[6] provide new, detailed evidence of bruising characteristics in context to the child's age and developmental capabilities. They analysed injuries resulting from eight recognised trauma mechanisms adapted from the International Classification of External Causes of Injury. Summarised results are based on 693 bruises from 559 incidents in children 13 years of age and younger. This prospective cross-sectional study is one of the first to add such detailed information on bruising characteristics in relation to specific injury events across different development stages. Strengths of this study include a high level of rigour to exclude potential abuse cases that might confound results, and the use of two different populations of patients (emergency department and community

Table 1 Bruise counts occurring from a single incident

Bruise count	Present in % of incidences	Mechanisms in which the bruises occurred
1	81.7	All mechanisms studied
2	13.8	All mechanisms studied
3	4.5	Uncommon; predominantly stair falls, sports and MVCs
4	0.5	Rare; one stair fall and two sports injuries
5	0.4	Rare; only present in two cases—both MVCs
>5	0	Did not occur

MVCs, motor vehicle crashes.

Table 2 Green flags: common bruise findings from unintentional injury to aid with assessing injury plausibility—Hibberd *et al*[6] study results with other supporting studies referenced

Bruise findings—single incident	General rule	Per cent occurrence and related injury details[6]
Number of bruises/incident	'One and done' is the rule Two to four bruises can occur from single incident[5 7]	**81.7**% of all incidents resulted in only one bruise. More than one bruise: motor vehicle crash, stair falls (10+ steps), sports, 2+ metre fall
Developmental state of child and mobility	Once you cruise, you are more likely to bruise.[9] Bruising frequency increases as mobility increases (from sitting up to running)[7 9]	**99%** of bruises occurred in mobile children; only seven incidents of bruising in non-mobile infants—all with clear, plausible stories
Location of bruise on body	Bony areas bruise more easily and thus more frequently[5 8]	**73%** of bruises occurred over bony areas (forehead, cheek, chin, elbows, knees and shin)
Anterior surfaces (face, torso and legs)	Forward falls in young children are common and bruise the front of the body most often[5 8]	**78%** of all bruises occurred to the front of the body

Correspondence to Dr Mary Clyde Pierce, Department of Pediatrics, Ann & Robert H. Lurie Children's Hospital of Chicago, Chicago, Illinois, USA; MPierce@luriechildrens.org

Table 3 Red flags: rare or absent bruise occurrences resulting from a single injury incident*

Bruise characteristics concerning for abuse	Unintentional injury history examples	Bruise or incident rare or low occurrence rates[6]
Posterior surface (torso, buttocks and legs)[3 5]	Most involved fall and hitting or impacting object	5% (35/693 bruises)
Linear pattern of bruising[4]	Fall on edge of furniture/frame	0.9% (5/559) incidents
Multiple (four or five) bruises from single incident[3]	Stair fall >10 steps, sports, motor vehicle crash	0.9% (5/559) incidents
Bruising to front and back of body from single incident	Hit by car; fall down 12 steps	0.3% (2/559) incidents
Petechial bruising[4]	High velocity—fall off horse	0.3% (1/293)† bruises
Ear, neck or genital bruise[3–5]	Did not occur	0% (0/693) bruises
More than five bruises[3–5]	Did not occur	0% (00/559) incidents

*Presence of these bruise characteristics raises a red flag, and injury plausibility should be assessed with caution. Hibberd *et al* identified no or low rates of occurrence for the following bruise characteristics in this unintentionally injured cohort, adding compelling evidence to the red flag nature of such findings.[6]
†Only cases enrolled from the emergency department were evaluated for petechia.

clinics) to improve generalisability. This well-done study establishes an evidence base to access injury plausibly regarding bruise characteristics and injury history. In addition, previously published red flags regarding bruising characteristics from physical abuse are further validated by the very absence or extremely low frequency of these 'red flag' findings in this cohort of patients with unintentional injuries.

This study on bruising from eight specific unintentional injuries provides several take away points.[6] Among the 372 children examined who had bruising, all but seven of these children were mobile, no one had more than five bruises from a single incident and the majority had only one bruise. Key, simple-to-apply findings from this study are synthesised in table 1.

The take home points regarding bruise counts are that three or more bruises occurring from a single incident is uncommon, and when present, one of the following mechanisms is expected: stair fall involving multiple stairs, sports injury or motor vehicle crash. More than five bruises from any stated cause brings into question the plausibility and veracity of the history for children who are otherwise healthy.

Hibbard *et al* found that bruises most often occurred to the front of the body over a bony area such as the forehead or shin. When two or more bruises did occur, they were in the same body region or on the same side of the body. Interestingly, there were only two incidents where bruising occurred to both the front and the back of the body from the same event. Patterned bruising was uncommon as was petechial or clustered bruising. Other researchers report similar results on developmental stage of the child, bruise count and appearance and distribution but none with the detail of this prospectively conducted study.[5 7–9]

Table 2 highlights key 'green flags' of bruising characteristics to aid with assessing injury plausibility as identified in the study by Hibberd *et al*.[6] Table 3 highlights potential red flags of abuse and reports on the low or no occurrences in this study of bruising from unintentional injury. References of similar findings from other studies are included.

In summary, the study by Hibberd *et al* provides a new level of evidence and improved accuracy for assessing injury plausibility and bruising.[6] Key identified factors in relation to the stated cause of injury includes the age of the child and developmental stage, the number of bruises and location of bruises on the body and whether the bruise is patterned or petechial. Knowing what bruise findings are consistent from a given mechanism of injury allows for improved recognition of when inconsistencies are present. Improved accuracy in injury assessments brings multifaceted benefits for children and families. Specifically, this knowledge has the potential to benefit the abused child by improving medical recognition of when a child's injuries from a stated cause are well out of the realm of plausible and the subsequently required legal evidence to support that opinion. Conversely, improved accuracy for assessing injuries in children also helps innocent families seeking care for their accidentally injured child by improving medical recognition of when a child's injuries fit well within expected outcomes for a specific mechanism of injury. Further work expanding on the evidence from this study has the potential to substantially improve the clinician's ability to differentiate abuse from accidental trauma. Such expansion might include prospective studies of all injury types occurring from the specified injury mechanisms regardless of bruise occurrence and enrolling a significantly larger sample size from many different emergency departments from diverse settings.

Competing interests None declared.

Patient consent Not applicable.

Provenance and peer review Commissioned; internally peer reviewed.

To cite Pierce MC. *Arch Dis Child* 2017;**102**:1097–1098.

Received 20 July 2017
Revised 29 August 2017
Accepted 31 August 2017
Published Online First 22 September 2017

► http://dx.doi.org/10.1136/archdischild-2017-312847
► http://dx.doi.org/10.1136/archdischild-2017-313449

Arch Dis Child 2017;**102**:1097–1098.
doi:10.1136/archdischild-2017-313367

REFERENCES

1 Sheets LK, Leach ME, Koszewski IJ, *et al*. Sentinel injuries in infants evaluated for child physical abuse. *Pediatrics* 2013;131:701–7.
2 Pierce MC, Kaczor K, Acker D, *et al*. History, injury, and psychosocial risk factor commonalities among cases of fatal and near-fatal physical child abuse. *Child Abuse Negl* 2017;69:263–77.
3 Dunstan FD, Guildea ZE, Kontos K, *et al*. A scoring system for bruise patterns: a tool for identifying abuse. *Arch Dis Child* 2002;86:330–3.
4 Kemp AM, Maguire SA, Nuttall D, *et al*. Bruising in children who are assessed for suspected physical abuse. *Arch Dis Child* 2014;99:108–13.
5 Pierce MC, Kaczor K, Aldridge S, *et al*. Bruising characteristics discriminating physical child abuse from accidental trauma. *Pediatrics* 2010;125:67–74.
6 Hibberd O, Nuttall D, Watson RE, *et al*. Childhood bruising distribution observed from eight mechanisms of unintentional injury. *Arch Dis Child* 2017;102:1103–9.
7 Carpenter RF. The prevalence and distribution of bruising in babies. *Arch Dis Child* 1999;80:363–6.
8 Kemp AM, Dunstan F, Nuttall D, *et al*. Patterns of bruising in preschool children-a longitudinal study. *Arch Dis Child* 2015;100:426–31.
9 Sugar NF, Taylor JA, Feldman KW. Bruises in infants and toddlers; those who don't cruise rarely bruise. *Arch Pediatr Adolesc Med* 1999;153:399–403.

Bruising characteristics from unintentional injuries in children: the 'green flag' study

Mary Clyde Pierce

*Arch Dis Child*2017 102: 1097-1098 originally published online September 22, 2017
doi: 10.1136/archdischild-2017-313367

Notes